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Abstract

Measurement of PM10 and PM2.5 Using SAW Sensors-Based Rayleigh Wave and Love Wave †

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Abstract: Particulate matter (PM) is reported to be dangerous and can cause respiratory and health issues. Regulations, based on PM concentration, have been implemented to limit human exposition to air pollution. An innovative system with surface acoustic wave (SAW) sensors combined with a 3 Lpm cascade impactor was developed by our team for real time mass concentration measurements. In this study, we compare the PM sensitivity of two types of SAW sensors. The first one consists of delay lines based on Rayleigh waves propagating on a Lithium Niobate Y-X 128° substrate. The second one is a based-on Love waves on AT-Quartz. Aerosols were generated from NaCl for PM2.5 and from Silicon carbide for PM10. The sensors' responses was compared to a reference sensor based on optical measurements. The sensitivity of the Rayleigh wave-based sensor is clearly lower than the Love wave sensor for both PMs. Although less sensitive, Rayleigh wave sensors remain very promising for the development of self-cleaning sensors using RF power due to their high electromechanical factor. To check the performance of our system in real conditions, we tested the sensitivity to PM from cigarette smoke using Rayleigh SAW. The PM2.5 stage showed a phase shift while the PM10 did not respond. This result agrees with previous studies which reported that the size of particles from cigarette smoke varies between 0.1 to 1.5 µm. A good correlation between the reference sensor's response and the phase variation of SAW sensors was obtained.

Keywords: PM; SAW sensors; cascade impactor; mainstream smoke; love waves; Rayleigh waves

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